

INVESTIGATION OF THE EFFECT OF THE AMOUNT
OF BODY USED ON THE ACCURACY AND CON-
SISTENCY OF PACE-RATING (MULTI-IMAGE
LOOP)'.
BY

FLAVIO MONTEIRO

THESIS
M685

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INVESTIGATION OF THE EFFECT OF
THE AMOUNT OF BODY USED
ON THE ACCURACY AND CONSISTENCY OF PAGE-RATING
(MULTI-IMAGE LOOP)

A thesis

Submitted to the Faculty

of

Purdue University

by

Flavio Monteiro

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Science in Industrial Engineering

June, 1951

Thesis
M685

INVESTIGATION OF THE EFFECT OF
THE RATIO OF WET WEIGHT
OF THE MOISTURE AND COMPOSITION OF WATER-EXTRACT
(MILK-LIQUOR 100%)
A Thesis
Submitted to the Faculty
of
Yale University
by
David Rosenberg
in partial fulfillment of the
Requirements for the Degree
of
Master of Science in Industrial Engineering
June, 1951

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TABLE OF CONTENTS

	Page
ABSTRACT	
INTRODUCTION.....	1
PURPOSE	5
PROCEDURE	6
DATA.....	11
DEFINITIONS AND EXPLANATION OF TERMS.....	13
RESULTS.....	14
CONCLUSIONS.....	16
SUGGESTIONS.....	18
APPENDIX A. TABLES OF DATA AND RESULTS.....	20
APPENDIX B. EXPLANATION OF STATISTICAL PROCEDURE.....	40
APPENDIX C. SAMPLE CALCULATIONS.....	44
BIBLIOGRAPHY.....	46

LIST OF TABLES

Table

Page

1. Display of the Significant Difference in Percentage Deviations Between the Unaided and the Aided Situations in the Class A Ratings, from the Viewpoint of Consistency at the 5% Level of Significance..... 21
2. Display of the Significant Difference in Percentage Deviations Between the Unaided and the Aided Situations in the Class B Ratings from the Viewpoint of Consistency, at the 5% Level of Significance..... 23
3. Display of the Significant Difference in Percentage Deviations Between the Unaided and the Aided Situations in the Class A Ratings from the Viewpoint of Accuracy, at the 5% Level of Significance..... 25
4. Display of the Significant Difference in Percentage Deviations Between the Unaided and the Aided Situations in the Class B Ratings from the Viewpoint of Accuracy, at the 5% Level of Significance..... 27
5. Percentages of the Class A Ratings Within Given Percentage Deviations from the Raw Ratings Average (Consistency) in the Aided and the Unaided Situations..... 29
6. Student's t Values Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situations in Table 5..... 30
7. Percentages of the Class B Ratings Within Given Percentage Deviations from the Raw Ratings Averages (Consistency) in the Unaided and the Aided Situations..... 31
8. Student's t Values Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situations in Table 7..... 32
9. Percentages of the Class A Ratings Within Given Percentage Deviations from the Corrected Ratings (Accuracy) in the Unaided and the Aided Situations..... 33

ABSTRACT

The Purdue Motion and Time Study Laboratory and some of the plants in American industry are using the multi-image loop to help the pace-rating step of the procedure used to determine time standards. The loop has been found helpful in improving accuracy and consistency, and it seems to be one of the best answers so far arrived at in this controversial field.

One of the objections presented as a weakness of the loop is that it shows only essentially an arm movement and raters have difficulty in comparing the pace as shown by this movement with other types of movement using different members of the body.

The author of this thesis endeavored to investigate the subject mentioned in the previous paragraph. Different jobs involving different body members were filmed at different paces and raters were asked to pace-rate them; first unaided, and secondly aided by the loop.

The results were compared and subjected to statistical analysis from the view point of both accuracy and consistency.

Results

1. From the point of view of accuracy:

a. The accuracy in rating was significantly improved, at least in some paces, in all jobs except the one consisting of walking. In this job, the accuracy in rating

ABSTRACT

The purpose of this study was to determine the accuracy of the gait in various laboratory and field tests to help the practicing step of the procedure used in determining gait accuracy. The test has been found helpful in laboratory accuracy and consistency, and it seems to be one of the best answers to the question as to the accuracy of the test.

One of the objectives presented as a measure of the test is that it should only essentially in the laboratory and field have difficulty in comparing the test of gait with other types of movement being different members of the body.

The author of this thesis endeavored to investigate the subject mentioned in the previous paragraph. Different foot involving different body members were filmed at different points and before and after were asked to pose in the same position, and accordingly aided by the test. The results were compared and subjected to statistical analysis from the view point of both accuracy and consistency.

Results

1. From the point of view of accuracy:
 - a. The accuracy in testing was significantly improved, at least in some cases, in all cases except the one consisting of walking. In this case, the accuracy in testing

was significantly poorer with the loop than without it.

b. In no case, except in the job consisting of walking, was rating significantly poorer with the loop than without it.

2. From the viewpoint of consistency:

a. The jobs consisting of full arm and forearm movement were the only ones that in all cases were rated significantly better when using the loop.

b. The jobs consisting of fingers and trunk movements were rated significantly poorer in the aided condition.

c. The jobs consisting of walking and wrist movement did not show conclusive results.

Conclusions

It can be said with a considerable amount of confidence, from the results already stated, that, except in the case of the walking job, the loop helped the raters considerably in improving their accuracy, even when it did not improve their consistency. This seems to indicate that the loop is a powerful means to impose a uniform concept of standard pace upon a group of individuals, except in the case of walking and, probably, movements of the whole body. Also, with due consideration given to the exception already pointed out, use of the loop seems to decrease the known tendency to rate low-paced performance high, and high-paced performances low.

was significantly poorer with the loop than without it.

b. In the case, except in the loop containing

of walking, the rating significantly poorer with the loop

than without it.

c. From the viewpoint of consistency:

1. The loop containing of feet and torso

movements with the loop was in all cases with better

significantly better when using the loop.

2. The loop containing of fingers and trunk

movements were rated significantly poorer in the case of the

condition.

3. The loop containing of walking and wrist

movements did not show consistent results.

Conclusion

It can be said with a considerable amount of confidence,

from the results already stated, that, except in the case of

the walking test, the loop helped the person considerably in

improving their accuracy, even when it did not improve their

consistency. This seems to indicate that the loop is a

powerful means to improve a person's concept of standard posture

upon a series of individual, except in the case of walking

and, probably, movements of the whole body. Also, with the

consistency given to the expansion already pointed out,

now at the loop seems to decrease the person's tendency to rate

low-rated performance high, and high-rated performance low.

It is concluded that the loop is a valuable aid in the study of posture

and, in the case of walking, it is a valuable aid in the study of posture

INVESTIGATION OF THE EFFECT OF
THE AMOUNT OF BODY USED
ON THE ACCURACY AND CONSISTENCY OF FACE-RATING
(MULTI-IMAGE LOOP)

INTRODUCTION

Time study has been, since its introduction in the field of Engineering, a fascinating and controversial subject. Besides other uses, Time Study is a great stride towards the highly appealing objective of having all the employees in an organization paid fairly and equitably.

However, even a small amount of thought can immediately show the enormous difficulties in setting these standards. As one goes deeper into the subject, the difficulties seem to increase both in degree and in amount.

Without doubt, the most difficult step in setting time standards is the appraisal of the effort that the operator is expending in performing the job being studied. Some leaders in the subject,⁽¹⁾ among them Dr.

1. Presgrave, R., "Dynamics of Time Study", New York, N. Y., Mc Graw-Hill Book Co., 1945.

M. E. Mundel ⁽²⁾ and his associates of the Purdue Motion and Time Study Laboratory, have tried to decrease the diffi-

Investigation of the subject of
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(Subject of the subject)

INTRODUCTION

The study has been, since its inception in the
field of engineering, a fascinating and controversial sub-
ject. Besides other uses, this study is a great source
towards the highly appealing objective of having all the
employees in an organization feel happy and satisfied.
However, even a small amount of knowledge can be used
to help solve the numerous difficulties in solving these
problems. As we move deeper into the subject, the differ-
ences seem to become more and more apparent.
Almost doubt, the most difficult step in solving
these problems is the question of the effort that the
operator is expending in performing the job being con-
sidered. This is the subject, it is worth noting.

1. "Psychology of the subject", New York, N. Y.,
the University Press, 1949.

2. "The subject of the subject" and the subject of the subject
and the subject of the subject, have been in the subject of the subject.

2. Mundel, M. E., "Motion and Time Study, Principles and Practice", New York, Prentice-Hall, 1950.

culty of this step by separating job difficulty from the rating. The rater, according to their procedure, is concerned with pace alone, and rates only this element of the performance; in other words, he pace-rates the performance. All other factors of the job are taken care of, posteriorly, by means of secondary adjustments.⁽³⁾

3. Mundel, M. E., "Motion and Time Study, Principles and Practice", New York, Prentice-Hall, 1950.

As a further way of improving rating procedure, Dr. Mundel and his associates developed a motion picture film that shows twelve images simultaneously; in each image, the same simple job is performed, the pace varying from image to image, ranging from 79 to 156 percent of normal pace. The job being performed involves essentially an arm movement. In order to facilitate continuous projection of the film for relatively long periods of time, the film used is in the form of a loop, with its ends cemented together. It is known as the multi-image loop and, in this thesis, will be called simply the loop.

It has been shown by a study of the works of Keim,⁽⁴⁾

Lehrer⁽⁵⁾ and Eila⁽⁶⁾, that among over 4,000 ratings ob-

-
4. Keim, J. A., "An Evaluation of Time Study Rating", Master's Thesis, Purdue University, 1950.
 5. Lehrer, R. M., "An Evaluation of Two Time Study Rating Aids", Master's Thesis, Purdue University, 1947.
 6. Eila, A. J., "An Analysis of Current Practice Unaided Time Study Rating", Master's Thesis, Purdue University, 1950.
-

tained from unaided experienced time study men, in 45% of the time the error in rating was greater than 10%. These results show how techniques to improve accuracy in rating, as the loop just described, are needed.

The loop has been evaluated against raw rating⁽⁷⁾ and other rating techniques and has been found helpful in improving in general both accuracy and consistency.⁽⁸⁾ How-

-
7. For detailed description of raw rating see: Eila, A. J., "An analysis of Current Practice Unaided Time Study Rating", Master's Thesis, Purdue University, 1950.
 8. Radkins, A. P., "Comparison and Evaluation of Three Time Study Rating Techniques", Masters Thesis, Purdue University, June, 1950. Mundel, M.-E., "Motion and Time Study, Principles and Practice", New York, Prentice-Hall, 1950. "Report of 5th. Annual Motion and Time Study Work Session, 1950", Purdue University.
-

ever, the investigations to-date definitely show that there is still a very large field for improvement, since the results of the use of the loop have been far from perfect. Its use still does not eliminate the human judgement existing in pace-rating, which is indeed the heart of the diffi-

culty of the step.

One of the objections that the users of the loop have offered is that it becomes difficult to compare the pace of the job being studied with those shown in the loop when the body member being used and the type of movement in the job differ markedly from those of the loop.⁽⁹⁾ The difficulty

9. Tseng, A. T., "An Evaluation of the Effectiveness of Retention of the Concept of a Standard Embodied in a Multi-Image Pace-Rating Loop", Unpublished Master's Thesis, Purdue University.

is easy to understand when one remembers that we are trying to evaluate accelerations of body members and that the impression of pace caused by different body members making different types of movements may vary, even if the acceleration in reality is the same.

copy of the book. . . .
one of the objections that the writer of the book gave
offered as that it is impossible to compare the facts of
the job being studied with those known in the job when the
body number being used and the type of movement in the job
differ materially from those of the book. (9) The attention

W. L. Brown, N. Y., "An Evaluation of the Attitudes of
Students of the University of a Standard-Excluded in a Study-
Image Case-Making Job", unpublished Master's Thesis,
Columbia University.

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PURPOSE

The purpose of this thesis is to investigate the effect of the amount of the body used on the consistency and accuracy of pace-rating, when the rater is using the multi-image loop as a rating aid. In other words, this thesis will investigate how ratings made with the help of the loop vary as the body members involved in the job being rated also vary.

INTRODUCTION

The purpose of this thesis is to investigate the effect of the amount of the body used on the consistency and accuracy of tests-taking, when the test is using the subject's own body as a testing aid. In other words, this thesis will investigate how ratings made with the help of the body vary as the body members involved in the job

being rated also vary.

The first chapter contains a general introduction to the study of the body as a testing aid. The second chapter contains a description of the method used in the study. The third chapter contains a description of the results of the study. The fourth chapter contains a discussion of the results of the study. The fifth chapter contains a summary of the study.

PROCEDURE

Six laboratory-type jobs were chosen by the author and filmed. The jobs were kept very simple and very definitely designed so as to have successively larger groups of body members involved in activity. Three paces of each job were filmed, the pace being controlled by a metronome. The following types of jobs were filmed:

Job 1. The operator turns a nut on a $3/4$ " bolt, using fingers only.

Job 2. The operator turns a 16 mm. movie wheel, supported on a rewinder, using mainly wrist motion.

Job 3. The operator touches successively two plate switches, about twenty inches apart, on a horizontal plan, using only fore-arm motion.

Job 4. The operator places metallic balls into a hole, one by one, after grasping them at a bin about seventeen inches from the hole; he uses here full arm motion.

Job 5. The operator picks up light small boxes from the floor one by one, and places them on the top of an average-size table thirty inches in height; the trunk is here the most important body member as far as the control of the pace goes. The operator

his laboratory-type test were common to the subject

and himself. The fact that they were very similar and very

different suggested to me in fact a considerable degree

of similarity in the way in which they were handled.

Some of the jobs were typed, the fact being established

by a comparison. The following types of jobs were typed:

Job 1. The operator typed a set of 100 words,

using finger tips.

Job 2. The operator typed a set of 100 words using

the fingers as a lever, using mainly

the fingers.

Job 3. The operator typed a set of 100 words using

the fingers, about equally using

the fingers, on a horizontal plane, using only

the fingers.

Job 4. The operator typed a set of 100 words using

the fingers, one by one, after pressing down

on a thin elastic membrane from the

side; he was told that was wrong.

Job 5. The operator typed a set of 100 words

from the front one by one, and placed them

on the top of an eraser-like block which

was in contact with the front of the

most important body member as far as the

position of the hand. The operator

was instructed to keep his arms rigid with respect to his trunk.

Job 6. The operator walks in front of the camera, normal to the axis of the lens of the camera.

Two groups of raters were used. One group was composed of students of the Elementary Motion and Time Study classes and will be called Group A, for convenience; the other group was composed of Staff Members of the Industrial Engineering Department and students of the Advanced Motion and Time Study classes with some experience in rating with the loop and will be called Group B. The first group have had no experience at all in rating.

The several sequences were filmed at the rate of 1,000 frames per minute and projected at the same speed. The films were cemented in sequence, in the following order. The paces were randomized:

Films order	Job and pace
1.	Job 1, slow.
2.	Job 4, medium
3.	Job 6, fast
4.	Job 2, fast
5.	Job 3, fast
6.	Job 5, medium
7.	Job 1, fast
8.	Job 4, fast
9.	Job 6, medium
10.	Job 2, medium
11.	Job 3, medium
12.	Job 5, slow
13.	Job 1, medium
14.	Job 4, slow
15.	Job 6, slow
16.	Job 2, slow

was instructed to keep his gun with

him at all times.

600 3. The officer was in front of the door,

pointing to the side of the door of the

door.

Two groups of men were made. One group was

made of students of the University of the

State and will be called Group 4. For convenience, the

other group was composed of staff members of the Industrial

Engineering Department and elements of the advanced class

and this group of men will have experience in testing with

the group and will be called Group 3. The first group was

not an experience at all in testing.

The several specimens were filmed at the rate of 1,000

frames per minute and projected at the same speed. The film

was connected in sequence, in the following order. The

specimens were randomized:

Specimen order

Job and Date

Job 1, 1/1/41	1.
Job 2, 1/1/41	2.
Job 3, 1/1/41	3.
Job 4, 1/1/41	4.
Job 5, 1/1/41	5.
Job 6, 1/1/41	6.
Job 7, 1/1/41	7.
Job 8, 1/1/41	8.
Job 9, 1/1/41	9.
Job 10, 1/1/41	10.
Job 11, 1/1/41	11.
Job 12, 1/1/41	12.
Job 13, 1/1/41	13.
Job 14, 1/1/41	14.
Job 15, 1/1/41	15.
Job 16, 1/1/41	16.

Films order

Job and pace

17.

Job 3, slow

18.

Job 5, fast

The words slow, medium and fast are used in this thesis only in a comparative sense within the same job.

The same set of instructions were written on a black-board each time the film was going to be shown to raters. The set of instructions consisted of the definition of pace, a caution to pay no attention to the job difficulty; and, when the loop was used, a statement asking raters to try to use the loop to its greatest possible advantage was added.

The raters first rated the sequence of jobs without the loop, based on their own individual concept of normal pace as defined by Dr. Mundel. All raters were quite familiar with this definition.

After a period of about two weeks, the sequence was again shown to the raters and the rating done with the help of the loop, projected side by side with the film. The correct pace of each image was shown also on a convenient place where it could be seen during rating. During both rating periods, the control of the speed of projection was made continuously with the aid of a strobotac, assuring the speed of 1,000 frames per minute.

The two weeks period was allowed in order to minimize any carry-over effect, i.e. the effect of the retention of the rating assigned in the unaided situation.

Before projecting the sequence of jobs, the loop alone

Test and page

Test order

Test 5, 1st
Test 6, 2nd

17.
18.

The words slow, medium and fast are used in this manual
only in a comparative sense within the same test.
The same set of instructions were written on a black-
board each time the test was given so it would be identical.
The set of instructions consisted of the definition of words,
a sentence to pay no attention to the job difficulty; and,
when the lamp was used, a statement asking persons to try
to use the lamp to its greatest possible advantage was added.
The persons first noted the responses of those without the
lamp, based on their own individual concept of normal pace
as defined by Mr. Samuel. All persons were given facilities
with this definition.
After a period of about ten minutes, the responses were
again shown to the persons and the testing done with the lamp
at the lamp, adjusted side by side with the first. The
outmost pace at which lamps were shown also as a comparison
place where it could be seen during testing. During these
testing periods, the control of the speed of projection was
made continuously with the aid of a stopwatch, starting and
stopping at 1,000 strokes per minute.
The two testing periods was allowed in order to maintain
any carry-over effect, i.e. the effect of the projection of
the testing material in the untested situation.
Between projecting the responses of John, the lamp alone

was projected for a period about 3 minutes. The objective of this was to give to the raters a chance to form in their mind a concept of several paces as shown by the loop.

After the data was gathered, two studies were made: one of the consistency of the group, and the other of the accuracy.

In the study of the consistency, the raw ratings average was taken, and the percentage of ratings that approached the raw average within 5, 7.5 and 10 percent was calculated, in each of the two situations, namely, unaided and aided. Then, the differences of percentages in each group and between the two situations were tested for significance using Student's *t* variable.

In the study of accuracy, since the true paces are unknown, a determination of values to be considered as true ones had to be adopted. The following was done in this thesis:

- a. The operator performing the job was paced by a metronome. This assured a reasonably constant pace, which was further checked by actual frame-counting.
- b. The metronome beats were taken as indicating the right proportionality among the paces of each individual job.
- c. In each job, the pace whose raw ratings

was subjected for a period about 3 minutes. The subjective
of this was to give to the patient a change in tone in their
and a concept of mental power as shown by the body.

After the time was elapsed, the results were noted and
at the beginning of the group, and the other of the group
they.

In the study of the consistency, the first study was
to see how, and the percentage of correct body responses
the two groups within 0, 7.5 and 10 percent was calculated.
But, in each of the two divisions, namely, mental and
also, then, the difference of percentage in each group
and between the two divisions were tested for significant
differences using Student's t statistic.

In the study of accuracy, since the true scores are
unknown, a distribution of values to be considered as
true ones had to be adopted. The following was then
the basis:

1. The operator performing the test was given
by a subject. This was a randomly
selected test, which was then repeated
by several times-repeating.

2. The response data was taken as initial
values for the study. The results were
the mean of each individual test.

3. In each test, the score whose raw ratings

average in the four conditions (unaided and aided in each of the two groups) agreed most closely was found. The mean of the averages in the four conditions was selected as the corrected rating for this pace. Then, the corrected rating for the other paces was determined proportionately with the help of the metronome beats.

After the corrected ratings were thus determined, the same procedure adopted in the study of consistency was used to study accuracy, the difference obviously being that the basis for the consistency study was the averages of the raw ratings, while the basis for the accuracy study was the corrected ratings.

studies in the four conditions involved the
 played in each of the two groups, which were
 closely as found. The mean of the variance
 in the four conditions was studied as the
 corrected testing for this case. Thus, the
 corrected testing for the other cases was
 determined proportionately with the help
 of the variance ratio.

After the corrected testing was determined,
 the new procedure adopted in the study of consistency
 was used to study accuracy, and difference consistency
 means that the basis for the consistency study was the
 accuracy of the test results, while the basis for the
 accuracy study was the corrected testing.

DATA

The data for this thesis was obtained from two groups of raters:

1. Group A. This group was composed of about 100 students of the Elementary Motion and Time Study classes; they had had no experience either in rating or in the use of the loop.

2. Group B. This group was composed of about 20 raters, some being staff members of the Industrial Engineering department and some being students of the Advanced Motion and Time Study classes. This group was experienced in rating and had already used the loop to some extent. However, no member of this group had continuous recent practice, in either rating or the use of the loop.

The two groups were separated for study in order to maintain their homogeneity as rating groups. This separation, added to the fact that the number of members of the group A is relatively large, permitted us to assume safely statistical normality to the samples (ratings) variations obtained from the latter group.

Due to the relatively small number of members of the group B, the assumption of normality of the distribution of the ratings could not be considered valid. Therefore, the reliability of the significance of the Student's test made is not nearly as high as that of the study run on the class A ratings. However, the study was made to see

DATA

The data for this analysis was obtained from two groups:

1. Group 1.

This group was composed of about 100 members of the Elementary Section and Time Study Division. They had no experience either in testing or in the use of the loop.

2. Group 2. This group was composed of about 50

members, some being party members of the Industrial Engineering Department and some being students of the advanced section and time study division. This group was experienced in testing and had already used the loop to some extent. However, no member of this group had conducted recent practice, in effect testing of the use of the loop.

The two groups were separated for study in order to maintain their homogeneity as testing groups. This separation, added to the fact that the number of members of the group 2 is relatively large, permitted us to make fairly statistical analysis of the samples (results) which were obtained from the latter group.

Due to the relatively small number of members of the group 1, the sampling of normality of the distribution of the results would not be considered valid. Therefore, the reliability of the significance of the results of the test is not nearly as high as that of the group 2. In fact, the group 2 results, the study was made to see

if the results would indicate considerable differences between the two groups. That was not the case.

Recognition must also be accorded to the fact that experience of raters varied widely within group B, but was constant within group A. For this reason, group B was used as an aid to establish the correct values for measuring accuracy, and comparisons of performances were made principally from ratings made by group A.

It is essential that the following instructions be followed
in the use of the apparatus. The first step is to
prepare the apparatus as shown in the diagram. The
apparatus must be used in the following manner:
The apparatus is used to measure the rate of
flow of gas through the apparatus. The rate of
flow is measured by the volume of gas collected
in the gasometer. The volume of gas collected
is measured by the height of the liquid in the
gasometer. The height of the liquid in the
gasometer is measured by the scale on the
gasometer. The scale on the gasometer is
marked in centimeters. The rate of flow is
calculated by dividing the volume of gas
collected by the time taken for the gas to
pass through the apparatus. The time taken for
the gas to pass through the apparatus is
measured by a stop watch. The rate of flow
is expressed in centimeters per second. The
rate of flow is measured at different
temperatures. The rate of flow is measured
at 10°C, 20°C, 30°C, 40°C, 50°C, 60°C,
70°C, 80°C, 90°C, and 100°C. The rate of
flow is measured at different pressures. The
rate of flow is measured at 1 atm, 2 atm,
3 atm, 4 atm, 5 atm, 6 atm, 7 atm, 8 atm,
9 atm, and 10 atm. The rate of flow is
measured at different concentrations of gas.
The rate of flow is measured at 10%, 20%,
30%, 40%, 50%, 60%, 70%, 80%, 90%, and
100% concentration of gas. The rate of flow
is measured at different rates of flow. The
rate of flow is measured at 1 cm/sec, 2 cm/sec,
3 cm/sec, 4 cm/sec, 5 cm/sec, 6 cm/sec,
7 cm/sec, 8 cm/sec, 9 cm/sec, and 10 cm/sec.
The rate of flow is measured at different
viscosities of gas. The rate of flow is
measured at 1 poise, 2 poise, 3 poise, 4 poise,
5 poise, 6 poise, 7 poise, 8 poise, 9 poise,
and 10 poise. The rate of flow is measured
at different densities of gas. The rate of
flow is measured at 1 g/cm³, 2 g/cm³, 3 g/cm³,
4 g/cm³, 5 g/cm³, 6 g/cm³, 7 g/cm³, 8 g/cm³,
9 g/cm³, and 10 g/cm³. The rate of flow
is measured at different molecular weights of
gas. The rate of flow is measured at 1 g/mol,
2 g/mol, 3 g/mol, 4 g/mol, 5 g/mol, 6 g/mol,
7 g/mol, 8 g/mol, 9 g/mol, and 10 g/mol.
The rate of flow is measured at different
molar masses of gas. The rate of flow is
measured at 1 g/mol, 2 g/mol, 3 g/mol, 4 g/mol,
5 g/mol, 6 g/mol, 7 g/mol, 8 g/mol, 9 g/mol,
and 10 g/mol. The rate of flow is measured
at different molecular weights of gas. The
rate of flow is measured at 1 g/mol, 2 g/mol,
3 g/mol, 4 g/mol, 5 g/mol, 6 g/mol, 7 g/mol,
8 g/mol, 9 g/mol, and 10 g/mol. The rate of
flow is measured at different molecular weights
of gas. The rate of flow is measured at 1 g/mol,
2 g/mol, 3 g/mol, 4 g/mol, 5 g/mol, 6 g/mol,
7 g/mol, 8 g/mol, 9 g/mol, and 10 g/mol.

DEFINITIONS AND EXPLANATION OF TERMS

Certain terms are used in the thesis with a particular meaning that may be unfamiliar to the reader. To avoid confusion due to this, these terms are defined as follows:

Pace

Pace is defined here as the amount of acceleration imparted by the operator on the body members in motion during the performance.

Normal Pace

100% on a scale with 130% representing maximum typical performance.

Consistency

Consistency expresses the degree to which ratings assigned to each performance by a group of raters agree with each other. See Procedure.

Accuracy

Accuracy expresses the degree to which the ratings assigned to each performance agree with the rating that should be assigned to the performance. Since the exact pace is truly unknown, what should be assigned as the rating of each performance has to be determined by some means. The way that this determination was made in this thesis is explained in the Procedure.

THEORY AND PRACTICE OF THE

The first part of the book is devoted to a general

discussion of the theory of the subject, and the

second part to the practice of the subject.

The book is written in a clear and concise

style.

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RESULTS

All the results arrived at in this thesis are shown in Appendix A.

Those results can be summarized as follows:

1. From the point of view of accuracy:

a. The accuracy in rating was significantly improved, at least in some cases, in all jobs except the one consisting of walking. In this job, the accuracy in rating was significantly poorer with the loop than without it.

b. In no case, except in the job consisting of walking, was rating significantly poorer with the loop than without it.

2. From the viewpoint of consistency:

a. The jobs consisting of full arm and forearm movement were the only ones that in all cases were rated significantly better when using the loop.

b. The jobs consisting of fingers and trunk movements were rated significantly poorer in the aided condition.

c. The jobs consisting of walking and wrist movement did not show conclusive results.

In order to show also the manner by which the use of the loop improved the accuracy of the raw averages of the class A group, a graph was drawn and inserted in Appendix A (Fig. 1). This graph shows that the use of the loop had a considerable effect in bringing the raw averages nearer to

RESULTS

All the results referred to in this section are shown

in Appendix A. The results are summarized as follows:

These results can be summarized as follows:

1. From the point of view of accuracy:

a. The accuracy in rating was significantly low.

viewed, at least in some cases, in all four cases the one
of accuracy of rating. In this case, however, is rating

was significantly poorer with the loop than without it.

b. In no case, change in the loop was significant

of rating, was rated significantly poorer with the loop

than without it.

2. From the viewpoint of consistency:

a. The loop consisting of full and half

movements were the only ones that in all cases were rated

significantly better than using the loop.

b. The loop consisting of finger and thumb

movements were rated significantly poorer in the same

condition.

c. The loop consisting of rolling and other

movements did not show comparative results.

In order to show with the accuracy of rating the use of

the loop improved the accuracy of the two averages of the

class A group, a graph was drawn and inserted in Appendix A

(Fig. 1). This graph shows that the use of the loop had a

considerable effect in obtaining the two averages better so

the 45° line, in other words, to the corrected values that should have been assigned to the several paces of the jobs. The only exception is the job consisting of walking whose unaided raw ratings averages were not helped by the loop to any degree, confirming the results already stated in the previous paragraph.

by and took to sea before, continuing the transfer directly within these loaded tow vessels averaged were not helped the loss. The only exception is the 100 consisting of that should have been included in the several parts of the 100 line, in other words, to the corrected values reported in the previous report.

CONCLUSIONS

The conclusions arrived at by the author should be considered with the following thoughts kept in mind:

1. Group A had had no experience in either pace-rating or the use of the loop. It has been already shown that the effectiveness of the loop increases considerably after a certain period of training and practice with it.(10)

10. Tseng, A. T., "An Evaluation of the Effectiveness of Retention of the Concept of a Standard Embodied in a Multi-Image Pace-Rating Loop", Unpublished Master's Thesis, Purdue University.

Therefore, the results arrived at in favor of the loop should be interpreted as having even greater significance. Also, the results against the loop should be regarded as possibly being due to a condition that could be eliminated or greatly reduced with further training and practice with the loop.

2. It has also been shown that the effectiveness of retention in an individual's mind of the concept of standard embodied in the loop is considerable.(11) The re-

11. Tseng, A. T., op. cit.

sults arrived at by group B have possibly been influenced

CONCLUSIONS

The conclusions arrived at by the author based on
 experiments with the following elements are as follows:
 1. Group A had no experience in either face-
 tracing or the use of the loop. It had been already known
 that the effectiveness of the loop increases considerably
 after a certain period of training and practice with it. (10)

10. Tread, A. T., "An Evaluation of the Effectiveness of
 the Loop in the Detection of a Suspect's Identity in a Multi-
 Image Face-Scanning Loop", Unpublished Doctor's Thesis,
 Indiana University.

Therefore, the results arrived at in favor of the loop
 should be interpreted as having even greater significance.
 Also, the results against the loop should be regarded as
 possibly being due to a condition that could be eliminated
 or greatly reduced with further training and practice with
 the loop.

2. It has also been shown that the effectiveness
 of detection in an individual's mind of the concept of
 repeated exposure in the loop is considerable. (11) The re-

11. Tread, A. T., op. cit.

results arrived at by Group B have possibly been influenced

by this. However, this could not have been the case with the results from Group A.

3. Because of the facts explained in the Data section of this thesis, the conclusions were drawn based mainly on the study made of the ratings from Group A.

The conclusions made by the author after a study of the results are:

1. Except in the job consisting of walking, the loop proved to be a powerful means to improve the accuracy of pace-rating, even when it did not improve consistency.

2. The loop proved to be considerably more valuable in improving the consistency of pace-rating in the cases of jobs involving body members identical to those shown in the loop, than in all the cases where the body members were other than those shown in the loop.

3. The loop seems to be a powerful means to establish a concept of standard among a group of individuals.

4. The loop proved to be particularly helpful in improving the accuracy of the ratings when the pace of the job is well above the normal. Unfortunately, the fast pace of the walking job (the only one whose ratings were not improved in accuracy) was not well above the normal. It was about 115%. Therefore, nothing can be said for this job in the aspect being considered in this paragraph.

by this. However, this could not have been the case with
the results from Group A.

3. Because of the large number of subjects in the
series of this study, the conclusions were drawn based
mainly on the study made of the results from Group A.

The conclusions made by the author after a study of
the results are:

1. Except in the job consisting of walking, the
loop proved to be a powerful means to improve the accuracy
of processing, even when it did not improve consistency.

2. The loop proved to be consistently more valuable
in improving the consistency of processing in the case of
jobs involving body numbers identical to those shown in the
loop, than in all the cases where the body numbers were always
those shown in the loop.

3. The loop seems to be a powerful means to
establish a concept of standard among a group of individuals.
4. The loop proved to be particularly helpful

in improving the accuracy of the results when the pace of
the job is well above the normal. Unfortunately, the test
pace of the walking job (the only one whose results were not
improved in accuracy) was not well above the normal. It was
about 1.5. Therefore, nothing can be said for this job in
the above being considered in this paragraph.

SUGGESTIONS

From the comments obtained from the raters who performed for this thesis and the author's own observations, the following suggestions are made here:

1. The length of time during which a job filmed should be exposed to the raters, in order to provide adequate time for comparison with the loop, should be investigated. The length of time used by the author, about 30 seconds, was considered too short by a few raters.

2. The number of images in a multi-image loop that can provide adequate spacing between the paces, and, at the same time, permit a quick and easy comparison between the loop and the job being studied should be investigated.

3. The author found out that there is no uniform mental process when raters use the loop. Some raters try first to obtain in their minds a good concept of the pace of the job being studied, and then they look at the loop for comparison. Other raters keep their eyes moving from the job to the loop and vice-versa, thus trying to make the comparison. It seems to the author that the first process is more efficient and even more accurate. However, this is just a personal opinion. The matter should be investigated. At least, in investigations in-

The following questions are asked here:

1. The length of time during which a job should be assigned to the worker, in order to provide maximum time for competition with the job, should be limited. The length of time used by the worker, about 30 seconds, was considered too short for a few tests.

2. The number of inmates in a self-insane hospital should not be so large as to require the appointment of a physician for each inmate, and the hospital should be so arranged as to permit a quick and easy transportation of the inmates to the hospital.

2. The answer found out that there is no real
formal process when there are no jobs. Some people
are first to appear in their minds a good example of the
fact of the job being created, and then they look at the
line for comparison. When there are no jobs, they are
then the job is the job and vice-versa, then trying to
make the comparison. It seems to me that the
line process is more efficient and even more accurate.
However, this is just a personal opinion. The answer
should be investigated, at least, in investigations in-

volving the loop, the procedure should be standardized.

4. It is possible that jobs involving the same pace of the same body member, but with different displacement or length of movement, may be rated differently; in other words, the tendency may be to count specific movements rather than to rate from an overall impression of acceleration. This might be a problem that would be interesting to investigate.

noting the fact, the procedure should be standardized.

4. It is possible that some leveling can occur

part of the same body member, but with different displace-

ment of length of movement, and be noted differently; in

other words, the tendency may be to count specific movements

rather than to note from an overall impression of overall

action. This might be a problem that would be interesting

to investigate.

5. The tendency of some to be "level" may be

related to the tendency to be "level" in the

same way as the tendency to be "level" in the

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APPENDIX A

TABLES OF DATA AND STATISTICAL RESULTS

Table 1. Display of the Significant Difference in Percentage Deviations Between the Unaided and the Aided Situations in the Class A Ratings, from the Viewpoint of Consistency at the 5% Level of Significance.

Key:

- means that no significant difference was found.
- *means that the difference was significant also at the 1% level of significance.
- \bar{A} means that the difference was against the use of the loop.
- F means that the difference was in favor of the use of the loop.

Table 1. Mapping of the Significant Differences
in Percentage Deviation Between the United and the
Aided Nations in the Class A Series, from the View-
point of Consistency at the 5% Level of Significance.

Key:
- means that no significant difference was found.
+ means that the difference was significant also at
the 1% level of significance.
! means that the difference was significant on the basis of
the 10% level.
x means that the difference was in favor of the non-
aided nations.

Slow pace Medium pace Fast pace

Job 1

Within 5%	A*	-	-
Within 7.5%	-	-	-
Within 10%	A*	-	A

Job 2

Within 5%	-	-	-
Within 7.5%	-	F	-
Within 10%	-	F*	A*

Job 3

Within 5%	-	F*	F
Within 7.5%	-	-	-
Within 10%	-	F*	-

Job 4

Within 5%	F*	-	-
Within 7.5%	F*	-	F*
Within 10%	-	-	F*

Job 5

Within 5%	A*	-	-
Within 7.5%	A*	A*	-
Within 10%	-	-	-

Job 6

Within 5%	-	F*	-
Within 7.5%	A*	A	-
Within 10%	A*	-	-

Table 1. - Flow Data - Station 100 - West Side

Job 1			
Station 100	100	100	100
Station 100	100	100	100
Station 100	100	100	100
Job 2			
Station 100	100	100	100
Station 100	100	100	100
Station 100	100	100	100
Job 3			
Station 100	100	100	100
Station 100	100	100	100
Station 100	100	100	100
Job 4			
Station 100	100	100	100
Station 100	100	100	100
Station 100	100	100	100
Job 5			
Station 100	100	100	100
Station 100	100	100	100
Station 100	100	100	100
Job 6			
Station 100	100	100	100
Station 100	100	100	100
Station 100	100	100	100

Table 2. Display of the Significant Difference in Percentage Deviations Between the Unaided and the Aided Situations in the Class B Ratings, from the Viewpoint of Consistency, at the 5% Level of Significance.

Key:

- means that no significant difference was found.
- * means that the difference was significant also at the 1% level of significance.
- \bar{A} means that the difference was against the use of the loop.
- F means that the difference was in favor of the use of the loop.

Table 1. Study of the significant differences in
percentage deviation between the United and the Soviet
divisions in the class 2 range, from the viewpoint of
consistency, at the level of significance.

Table 1

1961

Results from the significant differences and from
the results of the differences were significant also
at the level of significance.
I mean that the differences were significant and are of
the type.
Results from the differences was in favor of the use
of the type.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

	Slow pace	Medium pace	Fast pace
Job 1			
Within 5%	A	-	-
Within 7.5%	A	-	-
Within 10%	-	-	-
Job 2			
Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-
Job 3			
Within 5%	-	-	-
Within 7.5%	-	F ⁺	-
Within 10%	-	-	-
Job 4			
Within 5%	-	-	-
Within 7.5%	-	F	F ⁺
Within 10%	-	-	F
Job 5			
Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-
Job 6			
Within 5%	-	-	-
Within 7.5%	A	-	-
Within 10%	-	-	-

Table 1. (continued) (continued)

Loc 1			
Winn 25	4	-	-
Winn 7.5	1	-	-
Winn 10	-	-	-
Loc 2			
Winn 25	-	-	-
Winn 7.5	-	-	-
Winn 10	-	-	-
Loc 3			
Winn 25	-	-	-
Winn 7.5	-	-	-
Winn 10	-	-	-
Loc 4			
Winn 25	-	-	-
Winn 7.5	-	-	-
Winn 10	-	-	-
Loc 5			
Winn 25	-	-	-
Winn 7.5	-	-	-
Winn 10	-	-	-
Loc 6			
Winn 25	-	-	-
Winn 7.5	-	-	-
Winn 10	-	-	-
Loc 7			
Winn 25	-	-	-
Winn 7.5	-	-	-
Winn 10	-	-	-
Loc 8			
Winn 25	-	-	-
Winn 7.5	-	-	-
Winn 10	-	-	-
Loc 9			
Winn 25	-	-	-
Winn 7.5	-	-	-
Winn 10	-	-	-
Loc 10			
Winn 25	-	-	-
Winn 7.5	-	-	-
Winn 10	-	-	-

Table 3. Display of the Significant Difference in Percentage Deviations Between the Unaided and the Aided Situations in the Class A Ratings from the Viewpoint of Accuracy, at the 5% Level of Significance.

Key:

- means that no significant difference was found.
- * means that the difference was significant also at the 1% level of significance.
- A means that the difference was against the use of the loop.
- F means that the difference was in favor of the use of the loop.

Table 2. Display of the significant differences in percentage deviation between the United and the other stations in the class A station from the viewpoint of accuracy, at the level of significance.

Key:
 - means that no significant difference was found.
 * means that the difference was significant also at the 1% level of significance.
 A means that the difference was significant also at the 5% level.
 B means that the difference was in favor of the use of the loop.
 C means loop.

Station	Loop	Significance	Station	Loop	Significance
1	1	-	1	1	-
2	2	-	2	2	-
3	3	-	3	3	-
4	4	-	4	4	-
5	5	-	5	5	-
6	6	-	6	6	-
7	7	-	7	7	-
8	8	-	8	8	-
9	9	-	9	9	-
10	10	-	10	10	-
11	11	-	11	11	-
12	12	-	12	12	-
13	13	-	13	13	-
14	14	-	14	14	-
15	15	-	15	15	-
16	16	-	16	16	-
17	17	-	17	17	-
18	18	-	18	18	-
19	19	-	19	19	-
20	20	-	20	20	-
21	21	-	21	21	-
22	22	-	22	22	-
23	23	-	23	23	-
24	24	-	24	24	-
25	25	-	25	25	-
26	26	-	26	26	-
27	27	-	27	27	-
28	28	-	28	28	-
29	29	-	29	29	-
30	30	-	30	30	-
31	31	-	31	31	-
32	32	-	32	32	-
33	33	-	33	33	-
34	34	-	34	34	-
35	35	-	35	35	-
36	36	-	36	36	-
37	37	-	37	37	-
38	38	-	38	38	-
39	39	-	39	39	-
40	40	-	40	40	-
41	41	-	41	41	-
42	42	-	42	42	-
43	43	-	43	43	-
44	44	-	44	44	-
45	45	-	45	45	-
46	46	-	46	46	-
47	47	-	47	47	-
48	48	-	48	48	-
49	49	-	49	49	-
50	50	-	50	50	-

Slow pace Medium pace Fast pace

Job 1

Within 5%	-	-	-
Within 7.5%	-	-	F*
Within 10%	-	-	F*

Job 2

Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-

Job 3

Within 5%	-	-	-
Within 7.5%	-	F	F*
Within 10%	F	F	F*

Job 4

Within 5%	-	F*	F
Within 7.5%	-	F	F*
Within 10%	-	F*	F*

Job 5

Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-

Job 6

Within 5%	A	-	A*
Within 7.5%	-	-	A*
Within 10%	A	-	A*

Table 4. Display of the Significant Difference in Percentage Deviations Between the Unaided and the Aided Situations in the Class B Ratings from the Viewpoint of Accuracy, at the 5% Level of Significance.

Key:

- means that no significant difference was found.
- * means that the difference was significant also at the 1% level of significance.
- A means that the difference was against the use of the loop.
- F means that the difference was in favor of the use of the loop.

Table 1. Display of the significant differences in
 between the United and the United States
 distances in the United States from the viewpoint of
 accuracy, at the level of significance.

Key:
 - means that no significant difference was found.
 * means that the difference was significant at
 the 1% level of significance.
 † means that the difference was significant at the 5%
 level of significance.
 ‡ means that the difference was in favor of the
 at the 10% level.

Slow pace Medium pace Fast pace

Job 1

Within 5%	-	-	-
Within 7.5%	F*	F	-
Within 10%	F*	F	-

Job 2

Within 5%	F*	-	-
Within 7.5%	-	-	F*
Within 10%	-	-	F*

Job 3

Within 5%	F	-	F
Within 7.5%	-	F*	F*
Within 10%	-	F*	F*

Job 4

Within 5%	-	-	F*
Within 7.5%	F	-	-
Within 10%	-	-	-

Job 5

Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	F*	-	-

Job 6

Within 5%	-	-	-
Within 7.5%	A	-	-
Within 10%	-	-	-

slow pace medium pace fast pace

Top 1

Wichita 100	100	100	100
Wichita 7.50	7.50	7.50	7.50
Wichita 25	25	25	25

Top 2

Wichita 100	100	100	100
Wichita 7.50	7.50	7.50	7.50
Wichita 25	25	25	25

Top 3

Wichita 100	100	100	100
Wichita 7.50	7.50	7.50	7.50
Wichita 25	25	25	25

Top 4

Wichita 100	100	100	100
Wichita 7.50	7.50	7.50	7.50
Wichita 25	25	25	25

Top 5

Wichita 100	100	100	100
Wichita 7.50	7.50	7.50	7.50
Wichita 25	25	25	25

Top 6

Wichita 100	100	100	100
Wichita 7.50	7.50	7.50	7.50
Wichita 25	25	25	25

Table 5. Percentages of the Class A Ratings Within Given Percentage Deviations from the Raw Ratings Averages (Consistency) in the Aided and in the Unaided Situations.

Film No.	5%		7.5%		10%	
	U	A	U	A	U	A
1.	27.10	11.71	28.97	18.92	47.66	20.72
2.	27.36	27.93	43.39	44.14	57.58	58.56
3.	24.30	26.13	37.38	40.54	47.66	53.15
4.	22.43	13.51	22.43	27.03	60.75	42.34
5.	13.21	45.05	41.51	54.05	54.72	63.00
6.	20.75	18.18	44.34	21.82	44.34	37.27
7.	18.69	24.54	19.63	28.18	53.27	40.00
8.	41.12	37.27	41.12	62.73	43.93	71.82
9.	24.30	40.91	65.42	50.00	69.16	59.09
10.	25.23	32.43	29.91	44.14	29.91	59.46
11.	13.08	30.91	31.78	40.00	31.78	49.09
12.	46.73	29.36	61.68	39.45	63.55	55.05
13.	29.91	26.13	62.62	49.55	64.49	55.86
14.	14.95	45.95	14.95	62.16	62.62	67.57
15.	33.64	36.94	65.42	47.75	70.09	50.45
16.	22.43	27.03	45.79	45.95	50.47	53.56
17.	21.50	31.53	38.32	41.44	44.86	46.85
18.	23.36	32.43	43.93	51.35	56.07	61.26

Key: U; Unaided; A: Aided Situation.

Table 3. Comparison of the times of the first and second arrivals of the first and second arrivals from the two stations (Gorizont) in the field and in the United States.

Time no.	U	A	U	A	U	A
1.	27.10-11.71	28.07-15.45	27.10-11.71	28.07-15.45	27.10-11.71	28.07-15.45
2.	27.25-17.03	28.09-14.14	27.25-17.03	28.09-14.14	27.25-17.03	28.09-14.14
3.	24.20-10.13	27.03-10.34	24.20-10.13	27.03-10.34	24.20-10.13	27.03-10.34
4.	22.12-15.21	25.03-17.03	22.12-15.21	25.03-17.03	22.12-15.21	25.03-17.03
5.	19.21-12.03	41.31-24.03	19.21-12.03	41.31-24.03	19.21-12.03	41.31-24.03
6.	20.07-10.18	44.24-11.03	20.07-10.18	44.24-11.03	20.07-10.18	44.24-11.03
7.	18.09-12.34	19.03-23.18	18.09-12.34	19.03-23.18	18.09-12.34	19.03-23.18
8.	17.12-17.07	17.12-17.07	17.12-17.07	17.12-17.07	17.12-17.07	17.12-17.07
9.	14.30-10.21	22.02-20.00	14.30-10.21	22.02-20.00	14.30-10.21	22.02-20.00
10.	22.02-22.42	22.02-22.42	22.02-22.42	22.02-22.42	22.02-22.42	22.02-22.42
11.	12.02-20.21	21.02-10.00	12.02-20.21	21.02-10.00	12.02-20.21	21.02-10.00
12.	14.02-12.03	21.02-20.00	14.02-12.03	21.02-20.00	14.02-12.03	21.02-20.00
13.	22.02-20.12	22.02-20.00	22.02-20.12	22.02-20.00	22.02-20.12	22.02-20.00
14.	14.02-12.03	14.02-12.03	14.02-12.03	14.02-12.03	14.02-12.03	14.02-12.03
15.	22.02-20.04	22.02-20.00	22.02-20.04	22.02-20.00	22.02-20.04	22.02-20.00
16.	14.02-12.03	14.02-12.03	14.02-12.03	14.02-12.03	14.02-12.03	14.02-12.03
17.	21.02-21.03	22.02-21.03	21.02-21.03	22.02-21.03	21.02-21.03	22.02-21.03
18.	22.02-21.03	22.02-21.03	22.02-21.03	22.02-21.03	22.02-21.03	22.02-21.03

Key: U; United; A; United States.

Table 6. Student's t Values Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situations in Table 5.

Film No.	5%	7.5%	10%
1.	2.874	1.733	4.196
2.	0.094	0.111	0.147
3.	0.312	0.480	0.811
4.	1.719	0.789	2.720
5.	5.186	1.855	1.240
6.	0.310	3.560	1.065
7.	1.050	1.482	1.966
8.	0.584	3.197	4.188
9.	2.624	2.311	1.552
10.	1.176	2.179	7.103
11.	3.184	1.267	2.597
12.	2.644	3.280	1.280
13.	0.477	1.948	1.306
14.	4.984	7.164	0.769
15.	0.510	2.673	2.967
16.	0.788	0.011	1.200
17.	1.683	0.471	0.295
18.	1.494	1.099	0.779

Table 7. Percentages of the Class B Ratings Within Given Percentage Deviations from the Raw Ratings Averages (Consistency) in the Unaided and the Aided Situations.

Film No.	5%		7.5%		10%	
	U	A	U	A	U	A
1.	42.86	-11.76	52.38	-23.53	61.90	-47.07
2.	38.10	-66.67	38.10	-72.22	66.67	-72.22
3.	52.38	-22.22	52.38	-55.56	80.95	-55.56
4.	33.33	-33.33	57.14	-44.44	71.43	-50.00
5.	38.10	-50.00	47.62	-77.78	57.14	-83.33
6.	14.29	-22.22	47.62	-33.33	52.38	-66.67
7.	33.33	-33.33	33.33	-61.11	47.62	-72.22
8.	33.33	-50.55	38.10	-83.33	66.67	-94.44
9.	42.86	-22.22	61.90	-50.00	66.67	-50.00
10.	52.38	-47.06	52.38	-58.82	61.90	-70.59
11.	23.81	-33.33	28.57	-72.22	42.86	-72.22
12.	38.10	-22.22	38.10	-22.22	61.90	-66.67
13.	33.33	-22.22	52.38	-33.33	57.14	-33.33
14.	61.90	-38.89	61.90	-66.67	80.95	-77.78
15.	47.62	-22.22	66.67	-33.33	71.43	-50.00
16.	38.10	-27.78	47.62	-38.89	47.62	-44.44
17.	14.29	-27.78	23.81	-27.78	28.57	-44.44
18.	33.33	-27.78	33.33	-38.89	57.14	-66.67

Key: U: Unaided situation; A: Aided situation.

Table 7. Comparison of the class II ratings within
 given percentage portions from the new ratings averages
 (consistency) in the United and the rated situations.

Line no.	U		V		W	
	A	B	A	B	A	B
1.	42.11-11.70	02.12-12.02	41.10-10.07	01.11-11.08	40.09-09.06	00.10-10.07
2.	38.10-10.07	01.10-10.07	37.09-09.06	00.10-10.07	36.08-08.05	00.09-09.06
3.	34.09-09.06	00.10-10.07	33.08-08.05	00.09-09.06	32.07-07.04	00.08-08.05
4.	30.08-08.05	00.09-09.06	29.07-07.04	00.08-08.05	28.06-06.03	00.07-07.04
5.	26.07-07.04	00.07-07.04	25.06-06.03	00.06-06.03	24.05-05.02	00.05-05.02
6.	22.06-06.03	00.06-06.03	21.05-05.02	00.05-05.02	20.04-04.01	00.04-04.01
7.	18.05-05.02	00.05-05.02	17.04-04.01	00.04-04.01	16.03-03.00	00.03-03.00
8.	14.04-04.01	00.04-04.01	13.03-03.00	00.03-03.00	12.02-02.00	00.02-02.00
9.	10.03-03.00	00.03-03.00	09.02-02.00	00.02-02.00	08.01-01.00	00.01-01.00
10.	06.02-02.00	00.02-02.00	05.01-01.00	00.01-01.00	04.00-00.00	00.00-00.00
11.	04.01-01.00	00.01-01.00	03.00-00.00	00.00-00.00	02.00-00.00	00.00-00.00
12.	02.00-00.00	00.00-00.00	01.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00
13.	01.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00
14.	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00
15.	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00
16.	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00
17.	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00
18.	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00	00.00-00.00

Key: U: United situation; A: rated situation.

Table 8. Student's t Values Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situations in Table 7.

Film No.	5%	7.5%	10%
1.	2.145	2.117	0.932
2.	1.780	2.130	0.374
3.	1.929	0.202	1.713
4.	0	0.791	1.382
5.	0.747	1.929	1.765
6.	0.644	0.904	0.904
7.	0	1.734	1.557
8.	1.089	2.862	2.141
9.	1.363	0.747	1.055
10.	0.331	0.326	0.572
11.	0.658	2.720	1.844
12.	1.072	1.072	0.310
13.	0.768	1.197	1.486
14.	1.434	0.310	0.244
15.	1.648	2.077	1.382
16.	0.682	0.545	0.198
17.	1.040	0.284	1.030
18.	0.374	0.361	0.610

Table 3. Student's t Values calculated on Test the Difference Between the Values Given for the United and the United States in Table 7.

Item No.	U.S.	U.S.	U.S.
1.	2.140	2.117	0.982
2.	1.780	1.120	0.974
3.	1.822	0.802	1.718
4.	0	0.721	1.322
5.	0.717	1.929	1.722
6.	0.044	0.904	0.906
7.	0	1.724	1.337
8.	1.722	1.822	2.141
9.	1.222	0.722	1.222
10.	0.221	0.222	0.222
11.	0.822	2.722	1.244
12.	1.072	1.072	0.210
13.	0.700	1.127	1.422
14.	1.024	0.210	0.244
15.	1.042	2.072	1.222
16.	2.222	0.222	0.122
17.	1.020	0.222	1.020
18.	0.272	0.201	0.210

Table 3. Student's t Values calculated on Test the Difference Between the Values Given for the United and the United States in Table 7.

Table 9. Percentages of the Class A Ratings Within Given Percentage Deviations from the Corrected Ratings (Accuracy) in the Unaided and the Aided Situations.

Film No.	5%		7.5%		10%	
	U	A	U	A	U	A
1.	14.95-17.12		16.81-34.23		24.30-45.94	
2.	19.91-29.73		42.45-51.35		41.11-59.46	
3.	16.82-19.81		30.84-31.53		36.45-39.64	
4.	1.87- 6.31		2.80-24.32		5.61-30.61	
5.	6.60-16.21		6.60-21.62		6.60-21.62	
6.	19.81-22.27		37.83-36.36		37.92-45.45	
7.	0.93-15.45		3.74-24.54		13.08-33.64	
8.	2.80-12.73		11.21-32.73		11.21-53.64	
9.	45.79-41.82		47.66-51.82		69.16-60.91	
10.	38.32-36.94		58.88-52.25		60.75-63.96	
11.	5.61-17.27		5.61-24.54		7.48-40.00	
12.	21.49-28.44		26.17-37.61		26.17-50.46	
13.	3.74- 9.90		11.21-21.62		13.08-23.42	
14.	47.66-47.75		51.40-64.86		58.83-70.27	
15.	40.19-36.04		65.42-49.55		69.16-56.76	
16.	4.67-19.82		43.92-54.05		43.92-54.95	
17.	20.56-32.43		41.12-41.44		44.86-45.96	
18.	23.36-27.93		44.86-50.45		48.60-60.36	

Key: U: Unaided situation; A: Aided situation.

Table 1. Comparison of the observed and calculated values

of the observed values from the calculated values

(percentage) in the observed and the calculated values.

Observed	Calculated	Percentage	Observed	Calculated	Percentage
1.00-1.25	1.00-1.25	100	1.00-1.25	1.00-1.25	100
1.25-1.50	1.25-1.50	100	1.25-1.50	1.25-1.50	100
1.50-1.75	1.50-1.75	100	1.50-1.75	1.50-1.75	100
1.75-2.00	1.75-2.00	100	1.75-2.00	1.75-2.00	100
2.00-2.25	2.00-2.25	100	2.00-2.25	2.00-2.25	100
2.25-2.50	2.25-2.50	100	2.25-2.50	2.25-2.50	100
2.50-2.75	2.50-2.75	100	2.50-2.75	2.50-2.75	100
2.75-3.00	2.75-3.00	100	2.75-3.00	2.75-3.00	100
3.00-3.25	3.00-3.25	100	3.00-3.25	3.00-3.25	100
3.25-3.50	3.25-3.50	100	3.25-3.50	3.25-3.50	100
3.50-3.75	3.50-3.75	100	3.50-3.75	3.50-3.75	100
3.75-4.00	3.75-4.00	100	3.75-4.00	3.75-4.00	100
4.00-4.25	4.00-4.25	100	4.00-4.25	4.00-4.25	100
4.25-4.50	4.25-4.50	100	4.25-4.50	4.25-4.50	100
4.50-4.75	4.50-4.75	100	4.50-4.75	4.50-4.75	100
4.75-5.00	4.75-5.00	100	4.75-5.00	4.75-5.00	100
5.00-5.25	5.00-5.25	100	5.00-5.25	5.00-5.25	100
5.25-5.50	5.25-5.50	100	5.25-5.50	5.25-5.50	100
5.50-5.75	5.50-5.75	100	5.50-5.75	5.50-5.75	100
5.75-6.00	5.75-6.00	100	5.75-6.00	5.75-6.00	100
6.00-6.25	6.00-6.25	100	6.00-6.25	6.00-6.25	100
6.25-6.50	6.25-6.50	100	6.25-6.50	6.25-6.50	100
6.50-6.75	6.50-6.75	100	6.50-6.75	6.50-6.75	100
6.75-7.00	6.75-7.00	100	6.75-7.00	6.75-7.00	100
7.00-7.25	7.00-7.25	100	7.00-7.25	7.00-7.25	100
7.25-7.50	7.25-7.50	100	7.25-7.50	7.25-7.50	100
7.50-7.75	7.50-7.75	100	7.50-7.75	7.50-7.75	100
7.75-8.00	7.75-8.00	100	7.75-8.00	7.75-8.00	100
8.00-8.25	8.00-8.25	100	8.00-8.25	8.00-8.25	100
8.25-8.50	8.25-8.50	100	8.25-8.50	8.25-8.50	100
8.50-8.75	8.50-8.75	100	8.50-8.75	8.50-8.75	100
8.75-9.00	8.75-9.00	100	8.75-9.00	8.75-9.00	100
9.00-9.25	9.00-9.25	100	9.00-9.25	9.00-9.25	100
9.25-9.50	9.25-9.50	100	9.25-9.50	9.25-9.50	100
9.50-9.75	9.50-9.75	100	9.50-9.75	9.50-9.75	100
9.75-10.00	9.75-10.00	100	9.75-10.00	9.75-10.00	100

Key: 0 = Unlabeled specimen; 1 = Labeled specimen.

Table 10. Student's t Value Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situation in Table 9.

Film No.	5%	7.5%	10%
1.	0.438	2.966	3.360
2.	1.684	1.322	1.686
3.	0.573	0.110	0.487
4.	1.662	4.668	4.817
5.	2.266	3.196	3.196
6.	0.447	0.225	1.132
7.	0.279	0.225	0.360
8.	2.758	0.385	0.671
9.	0.594	0.617	1.283
10.	0.211	0.989	0.491
11.	0.855	3.945	6.000
12.	1.192	1.821	4.432
13.	1.604	2.082	1.988
14.	0.013	2.024	1.765
15.	0.633	2.382	1.898
16.	3.435	1.502	1.636
17.	1.994	0.048	0.164
18.	0.778	0.830	1.752

and the light situation in Table 2.

Year	1980	1981	1982
1980	1.000	1.000	1.000
1981	1.000	1.000	1.000
1982	1.000	1.000	1.000
1983	1.000	1.000	1.000
1984	1.000	1.000	1.000
1985	1.000	1.000	1.000
1986	1.000	1.000	1.000
1987	1.000	1.000	1.000
1988	1.000	1.000	1.000
1989	1.000	1.000	1.000
1990	1.000	1.000	1.000
1991	1.000	1.000	1.000
1992	1.000	1.000	1.000
1993	1.000	1.000	1.000
1994	1.000	1.000	1.000
1995	1.000	1.000	1.000
1996	1.000	1.000	1.000
1997	1.000	1.000	1.000
1998	1.000	1.000	1.000
1999	1.000	1.000	1.000
2000	1.000	1.000	1.000
2001	1.000	1.000	1.000
2002	1.000	1.000	1.000
2003	1.000	1.000	1.000
2004	1.000	1.000	1.000
2005	1.000	1.000	1.000
2006	1.000	1.000	1.000
2007	1.000	1.000	1.000
2008	1.000	1.000	1.000
2009	1.000	1.000	1.000
2010	1.000	1.000	1.000
2011	1.000	1.000	1.000
2012	1.000	1.000	1.000
2013	1.000	1.000	1.000
2014	1.000	1.000	1.000
2015	1.000	1.000	1.000
2016	1.000	1.000	1.000
2017	1.000	1.000	1.000
2018	1.000	1.000	1.000
2019	1.000	1.000	1.000
2020	1.000	1.000	1.000
2021	1.000	1.000	1.000
2022	1.000	1.000	1.000
2023	1.000	1.000	1.000
2024	1.000	1.000	1.000
2025	1.000	1.000	1.000
2026	1.000	1.000	1.000
2027	1.000	1.000	1.000
2028	1.000	1.000	1.000
2029	1.000	1.000	1.000
2030	1.000	1.000	1.000
2031	1.000	1.000	1.000
2032	1.000	1.000	1.000
2033	1.000	1.000	1.000
2034	1.000	1.000	1.000
2035	1.000	1.000	1.000
2036	1.000	1.000	1.000
2037	1.000	1.000	1.000
2038	1.000	1.000	1.000
2039	1.000	1.000	1.000
2040	1.000	1.000	1.000
2041	1.000	1.000	1.000
2042	1.000	1.000	1.000
2043	1.000	1.000	1.000
2044	1.000	1.000	1.000
2045	1.000	1.000	1.000
2046	1.000	1.000	1.000
2047	1.000	1.000	1.000
2048	1.000	1.000	1.000
2049	1.000	1.000	1.000
2050	1.000	1.000	1.000
2051	1.000	1.000	1.000
2052	1.000	1.000	1.000
2053	1.000	1.000	1.000
2054	1.000	1.000	1.000
2055	1.000	1.000	1.000
2056	1.000	1.000	1.000
2057	1.000	1.000	1.000
2058	1.000	1.000	1.000
2059	1.000	1.000	1.000
2060	1.000	1.000	1.000

Table 11. Percentages of the Class B Ratings Within Given Percentage Deviations from the Corrected Ratings (Accuracy) in the Unaided and the Aided Situations.

Film No.	5%		7.5%		10%	
	U	A	U	A	U	A
1.	38.09	23.53	47.62	23.53	57.14	35.29
2.	19.09	66.67	33.33	72.22	38.09	72.22
3.	42.86	5.55	52.38	5.55	71.42	16.67
4.	28.57	11.11	38.09	16.67	42.86	44.44
5.	14.28	38.89	14.28	55.55	14.28	61.11
6.	42.86	27.78	47.62	33.33	47.62	55.55
7.	4.76	33.33	4.76	50.00	19.05	72.22
8.	4.76	38.89	14.28	66.67	23.81	72.22
9.	42.85	38.89	47.61	38.89	71.43	61.11
10.	47.62	47.05	61.90	58.82	61.90	70.59
11.	14.28	33.33	14.28	44.44	33.33	72.22
12.	47.62	27.78	52.38	38.89	52.38	50.00
13.	19.05	22.22	38.10	38.89	47.62	44.44
14.	61.90	38.89	71.42	61.11	80.95	66.67
15.	47.62	16.67	52.38	33.33	71.42	38.89
16.	9.52	11.11	42.86	38.89	42.86	38.89
17.	14.28	38.89	19.05	44.44	23.81	55.55
18.	23.81	33.33	71.42	66.67	71.42	66.67

Key: U: Unaided situation; A: Aided situation.

Table II. Investigation of the Effect of the Amount of the
 Given Percentage Deviation from the Corrected Reading
 (Accuracy) in the United States Navy's Altimeters.

Alt. No.	U. S. A.	U. S. A.	U. S. A.
1.	20.00-20.00	20.00-20.00	20.00-20.00
2.	10.00-20.00	20.00-20.00	20.00-20.00
3.	00.00-20.00	20.00-20.00	20.00-20.00
4.	20.00-11.11	20.00-11.11	20.00-11.11
5.	10.00-20.00	10.00-20.00	10.00-20.00
6.	00.00-20.00	00.00-20.00	00.00-20.00
7.	00.00-20.00	00.00-20.00	00.00-20.00
8.	00.00-20.00	00.00-20.00	00.00-20.00
9.	00.00-20.00	00.00-20.00	00.00-20.00
10.	00.00-20.00	00.00-20.00	00.00-20.00
11.	00.00-20.00	00.00-20.00	00.00-20.00
12.	00.00-20.00	00.00-20.00	00.00-20.00
13.	00.00-20.00	00.00-20.00	00.00-20.00
14.	00.00-20.00	00.00-20.00	00.00-20.00
15.	00.00-20.00	00.00-20.00	00.00-20.00
16.	00.00-20.00	00.00-20.00	00.00-20.00
17.	00.00-20.00	00.00-20.00	00.00-20.00
18.	00.00-20.00	00.00-20.00	00.00-20.00

Key: U. S. United States; A. Altimeter.

Table 12. Student's t Value Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situation in Table 11.

Film No.	5%	7.5%	10%
1.	0.977	1.557	1.363
2.	3.011	2.423	4.558
3.	2.666	3.159	3.417
4.	1.346	1.481	0.992
5.	1.759	2.726	3.038
6.	0.978	0.904	0.494
7.	1.808	2.818	3.340
8.	2.144	3.352	3.022
9.	0.251	0.548	0.682
10.	0	0.196	0.572
11.	1.408	2.085	2.423
12.	1.269	0.842	0.148
13.	0.244	0	0.198
14.	1.434	0.682	1.021
15.	2.044	1.197	2.043
16.	0.163	0.249	0.249
17.	1.759	1.713	2.030
18.	0.658	0.320	0.320

Table 13. Values of the Means of the Raw Ratings in the Unaided and the Aided Situations for Each of the Two Groups (A and B) Used as a Basis for the Study of Consistency.

Film No.	Class A		Class B	
	U	A	U	A
1.	88.79	-106.21	99.19	-111.12
2.	122.12	-125.29	119.52	-128.61
3.	127.90	-127.97	120.52	-139.55
4.	93.06	-107.40	105.33	-115.94
5.	137.12	-153.96	154.76	-170.83
6.	117.96	-108.83	106.90	-105.28
7.	103.64	-125.00	114.76	-138.67
8.	136.10	-151.67	142.90	-159.11
9.	106.59	-105.19	104.38	-112.44
10.	89.40	- 98.86	99.38	- 99.71
11.	112.66	-129.84	131.14	-149.67
12.	97.85	- 92.04	91.90	- 88.00
13.	95.70	-105.68	103.67	-111.78
14.	92.89	- 99.79	97.38	-106.11
15.	94.53	- 94.67	98.57	- 94.17
16.	75.73	- 85.87	85.95	- 90.50
17.	83.90	- 95.90	91.83	-105.17
18.	128.44	-129.36	119.67	-130.39

Note: The films selected as those where best agreement between ratings were found are: 1, 10, 14, 17, 18 and 15.

Table 14. Corrected Ratings Taken as Basis for the
Study of Accuracy.

Film No.	Corrected Ratings
1.	101.33
2.	123.80
3.	115.94
4.	111.48
5.	117.95
6.	104.29
7.	141.86
8.	170.84
9.	101.45
10.	96.84
11.	146.55
12.	90.69
13.	118.22
14.	99.04
15.	95.48
16.	84.26
17.	94.21
18.	126.96

TABLE 12. CORRELATED ARIAL TONAL OR BEATS FOR 600

Special of Acoustic.

Correlated Aerial Tonal or Beats for 600

101.52	1.
102.50	2.
110.50	3.
111.50	4.
117.50	5.
104.50	6.
141.50	7.
170.50	8.
101.50	9.
98.50	10.
145.50	11.
90.50	12.
118.50	13.
99.00	14.
98.40	15.
98.30	16.
94.51	17.
128.00	18.
	19.
	20.

These figures are based on the assumption that the tone is 600 cycles per second.

FIGURE 1

GRAPHICAL DISPLAY OF THE RAW RATINGS AVERAGES
OF GROUP A
IN THE UNAIDED AND IN THE AIDED SITUATION

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REPORT OF THE NATIONAL BUREAU OF STANDARDS FOR THE YEAR 1917

CONTENTS

1. GENERAL INFORMATION 1

2. PHYSICAL STANDARDS 2

3. CHEMICAL STANDARDS 3

4. METROLOGICAL STANDARDS 4

5. STANDARDS OF TIME 5

6. STANDARDS OF WEIGHT AND MEASURE 6

7. STANDARDS OF LENGTH 7

8. STANDARDS OF MASS 8

9. STANDARDS OF TEMPERATURE 9

10. STANDARDS OF PRESSURE 10

11. STANDARDS OF FORCE 11

12. STANDARDS OF ENERGY 12

13. STANDARDS OF POWER 13

14. STANDARDS OF CAPACITY 14

15. STANDARDS OF AREA 15

16. STANDARDS OF VOLUME 16

17. STANDARDS OF SURFACE 17

18. STANDARDS OF PERCENTAGE 18

19. STANDARDS OF RATIO 19

20. STANDARDS OF PROPORTION 20

21. STANDARDS OF SIMILITUDE 21

22. STANDARDS OF CONGRUENCE 22

23. STANDARDS OF EQUALITY 23

24. STANDARDS OF INEQUALITY 24

25. STANDARDS OF ORDER 25

Fig. 1

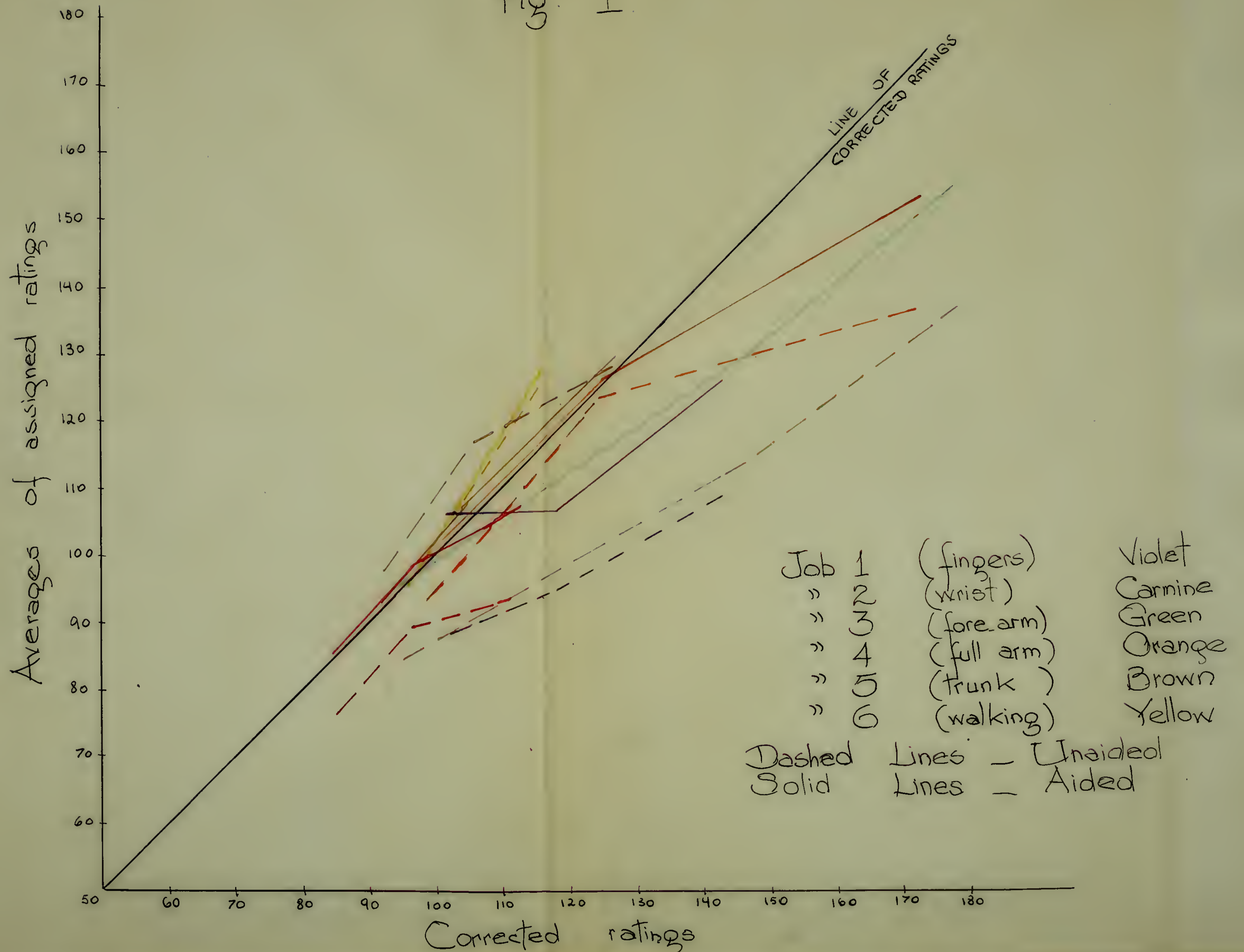
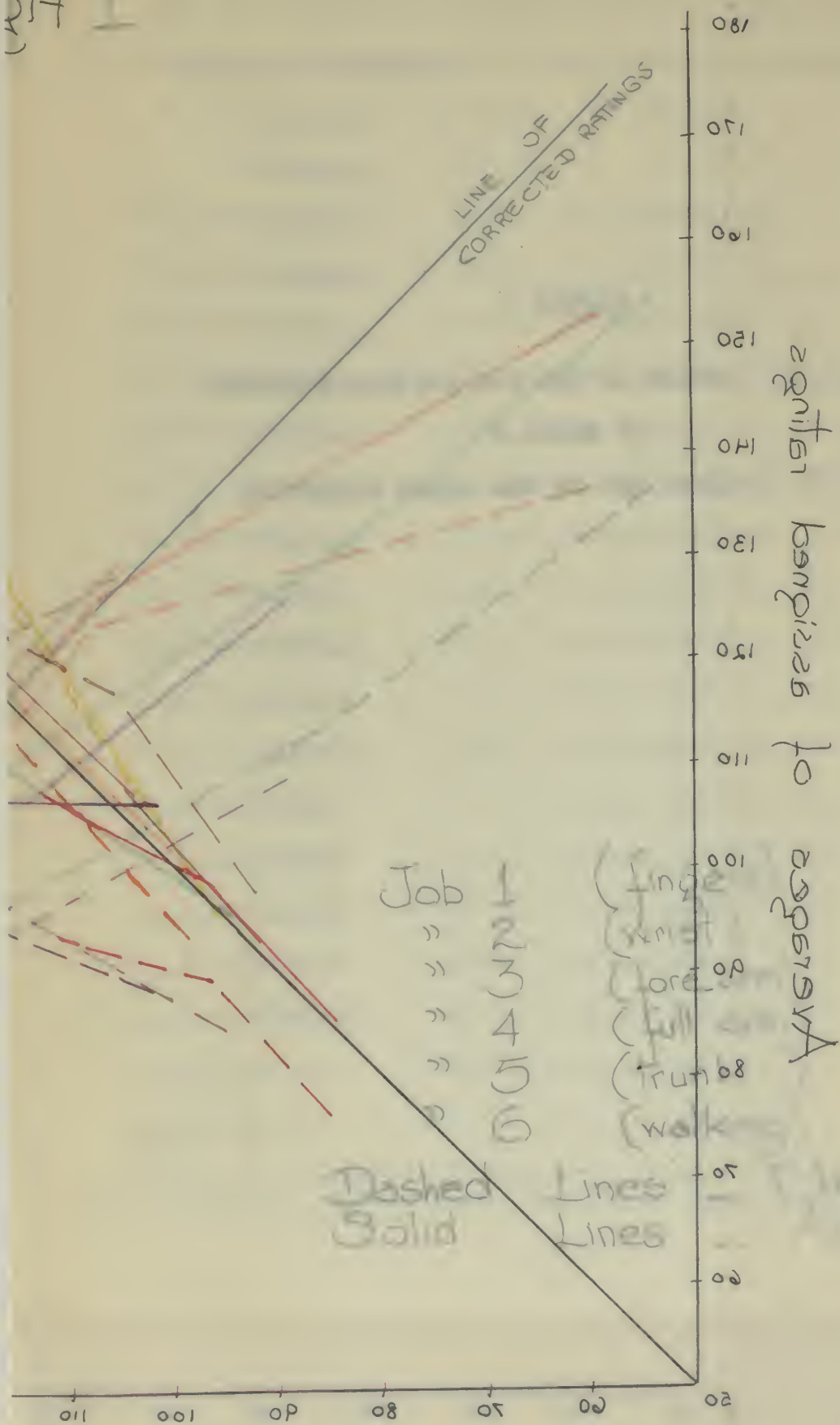


Fig 1



APPENDIX B

EXPLANATION OF STATISTICAL PROCEDURE

(M. WICKSTEDT) (C)
 ESTIMATION BY MULTIPLE REGRESSION



EXPLANATION OF STATISTICAL PROCEDURE

The percentages of ratings within given percentage deviations from the raw averages and from the corrected ratings, found respectively in the studies of consistency and accuracy, were tested for significance by means of the Student's t variable.

This test requires the assumption that the ratings obtained came from a normally distributed population.⁽¹²⁾

12. Edwards, A., "Experimental design in Psychological Research", New York, Mc Graw-Hill Book Co., 1950.

This assumption was made as explained in the Data section of this thesis.

The formula used to express Student's t variable was:

$$t = \frac{p_1 - p_2}{e}$$

where p_1 is the percentage deviation from the raw ratings average, in the consistency study, or from the corrected rating, in the accuracy study, in the unaided situation; p_2 is the same statistics in the aided situation and e is the standard error of the quantity $p_1 - p_2$, being given by the formula:

ANALYSIS OF VARIATIONAL TECHNIQUE

The percentages of trials within given percentage
 deviation from the two averages and from the corrected
 average, found respectively in the analysis of consistency
 and accuracy, were tested for significance by means of the
 Student's t statistic.

This test requires the assumption that the trials ob-
 tained came from a normally distributed population. (12)

12. Student, W., "Experimental Design in Psychological
 Research", New York, Mc Graw-Hill Book Co., 1930.

This assumption was made as required in the same section
 of this thesis.
 The formula used to express Student's t statistic was:

$$t = \frac{p_1 - p_2}{s}$$

where p_1 is the percentage deviation from the two averages
 average, in the consistency study, or from the corrected
 average, in the accuracy study, in the unaided situation;
 p_2 is the same statistic in the aided situation and s
 is the standard error of the quantity $p_1 - p_2$, being
 given by the formula:

$$e = \sqrt{ab \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}$$

where:

$$a = \frac{n_1 p_1 + n_2 p_2}{n_1 + n_2} \quad \text{and} \quad b = 1 - a$$

and n_1 and n_2 are the number of ratings used in each situation. The number of degrees of freedom is given by the formula:

$$d. f. = n_1 + n_2 - 2$$

The test consisted of proposing the hypothesis that the percentage deviations found were typical percentage deviations drawn from a normal population. The value of t was calculated and compared with the limiting values of t given by a table.⁽¹³⁾ If the value of t calculated is

13. C. C. Peters and R. Van Voorhis, "Statistical Procedures and Their Mathematical Basis", New York, Mc Graw-Hill Book Co., 1940.

greater than the table value, at the level of significance chosen, the hypothesis is not tenable; in other words, there is a difference between the two percentages considered which is greater than should be expected of typi-

$$s = \sqrt{\frac{1}{n} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}$$

where: s = standard deviation of the difference between the two groups

$$s = \sqrt{\frac{s_1^2 + s_2^2}{2}} \quad \text{and} \quad s = 1 \quad \text{and} \quad s = 1$$

and n_1 and n_2 are the number of ratings used in each group.
The number of degrees of freedom is given by the
formula:

$$D.F. = n_1 + n_2 - 2$$

The test statistic of proposing the hypothesis that
the percentage deviations found were typical percentages
deviations given from a normal population. The value of t
was calculated and compared with the critical value of t
given by a table (13) in the value of a deviation is

J. D. Jeffers and R. Van Nostrand, "Statistical Procedures
and Their Computational Data", New York, Mc Graw-Hill Book
Co., 1940.

greater than the table value. At the level of significance
chosen, the hypothesis is not rejected; in other words,
there is a difference between the two percentages found.
stated which is greater than should be expected at 5%.

cal percentage deviations drawn from normal population.

Two levels of significance were chosen: 1% and 5%.

Statistically speaking, a statement is made at the $n\%$ level of significance when one has only n chances out of 100 that the statement made is not true.

The limiting values of t for the number of degrees of freedom involved in all cases were:

At 1% level of significance: $t = 2.58$

At 5% level of significance: $t = 1.97$

The number of ratings obtained were as follows:

Group A

Unaided: 107

Aided: 111

Group B

Unaided: 21

Aided: 18

and percentage deviation drawn from normal population.
Two levels of significance were chosen: 5% and 25%.
Statistically speaking, a statement is made as the
level of significance when one has only a random set of
100 and the statement made is not true.
The limiting values of χ^2 for the number of degrees of

freedom involved in all cases were:

5% level of significance: $\chi^2 = 3.84$
25% level of significance: $\chi^2 = 1.39$

The number of ratings obtained were as follows:

Group A

Graded: 107

Ungraded: 111

Group B

Graded: 51

Ungraded: 18

APPENDIX C

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS

Calculation of mean or average values, example from Group B, unaided, film no. 1:

$$M = \frac{\sum \text{ratings}}{\text{No. of ratings}} = \frac{2083}{21} = 99.19$$

Calculations of the percentage of ratings within given percentage deviations from the corrected ratings, example from Group A, unaided, film no. 1:

$$M = 101.33$$

$$\begin{array}{l} M \pm 5\% \\ 96.26 \text{ to } 106.40 \\ \frac{100 \times 16}{107} = 14.95 \end{array}$$

$$\begin{array}{l} M \pm 7.5\% \\ 93.37 \text{ to } 108.93 \\ \frac{100 \times 18}{107} = 16.82 \end{array}$$

$$\begin{array}{l} M \pm 10\% \\ 91.20 \text{ to } 111.46 \\ \frac{100 \times 26}{107} = 24.30 \end{array}$$

Calculations of Student's t values, example from Group A, accuracy, film no. 1, within 5%:

$$t = \frac{0.1712 - 0.1495}{\sqrt{0.1603 \times 0.8397 \left(\frac{1}{107} + \frac{1}{107} \right)}} = 0.438$$

Significance: not significant at both 1% and 5% levels.

STATISTICAL ANALYSIS

Calculation of mean or average values, example from

Group 1, unaided, film no. 1:

$$\bar{x} = \frac{\sum x_i}{n} = \frac{100}{11} = 9.09$$

Calculation of the percentage of values within given

percentage deviation from the average value, example

from Group 1, unaided, film no. 1:

$$\bar{x} = 9.09$$

$$\bar{x} \pm 1\sigma = 9.09 \pm 1.11$$

$$\bar{x} \pm 1\sigma = 9.09 \pm 1.11$$

$$\bar{x} \pm 1\sigma = 9.09 \pm 1.11$$

$$\frac{100 \times 22}{100} = 22.00$$

$$\frac{100 \times 18}{100} = 18.00$$

$$\frac{100 \times 18}{100} = 18.00$$

Calculation of standard deviation, example from Group

1, unaided, film no. 1, series C:

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}} = \sqrt{\frac{0.111 + 0.111 + 0.111 + 0.111 + 0.111 + 0.111 + 0.111 + 0.111 + 0.111 + 0.111 + 0.111}{10}} = 0.33$$

Significance: not significant at 5% and 1% levels.

Metronome beats and frames per cycle

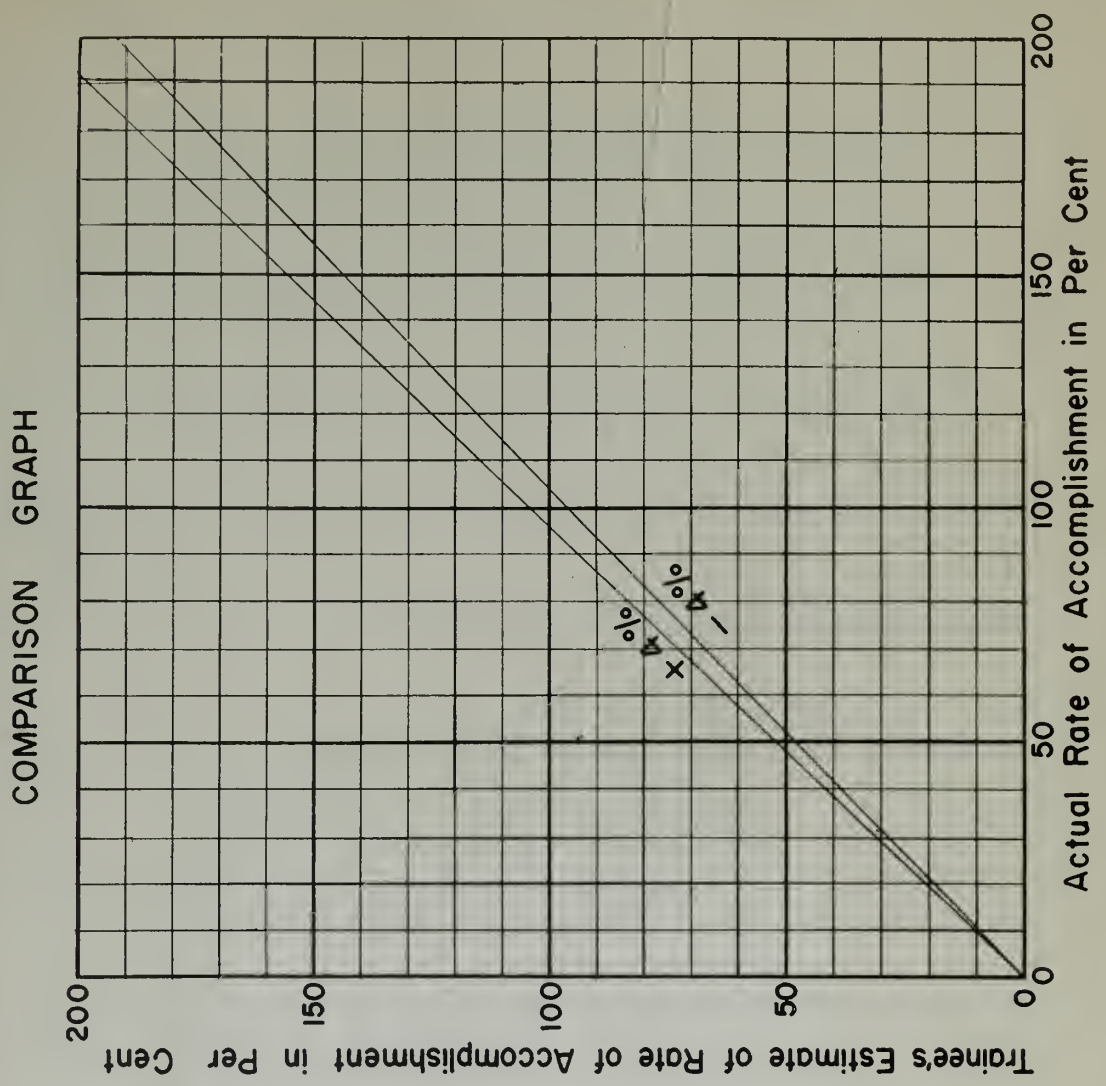
Film no.	Metronome	Frames/cycle
1	120	9
2	100	21
3	176	14
4	80	13
5	204	10
6	70	29
7	168	6
8	138	15
9	154	16
10	70	15
11	168	12
12	60	33
13	144	7
14	80	26
15	130	19
16	60	17
17	108	19
18	84	24

Experiments with the new type of cycle

Time No.	Experiments	Experiments / Cycle
1	120	9
2	100	12
3	178	14
4	80	15
5	104	10
6	70	22
7	168	8
8	132	12
9	152	16
10	70	15
11	162	12
12	180	22
13	162	7
14	160	22
15	130	16
16	60	17
17	102	10
18	82	22

OPERATION

Sequence Number	Rating of Accomplishment in Per Cent	
	Trainee's	Actual
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		



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OPERATION

COMPARISON SHEET

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15636

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body used on the accu-
racy and consistency of
pace-rating (multi-image
loop).

Thesis

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